

What is the relationship between eating frequency and nutrient intake?

Conclusion

Inadequate evidence is available to evaluate the relationship between eating frequency and nutrient intakes.

Grade: Limited

Overall strength of the available supporting evidence: Strong; Moderate; Limited; Expert Opinion Only; Grade not assignable For additional information regarding how to interpret grades, [click here](#).

Evidence Summary Overview

Only three cross-sectional studies published since 2004 (Kerver JM et al, 2006; Macdiarmid J et al, 2009; and Storey KE et al, 2000), met the criteria for review to evaluate the relationship between eating frequency and nutrient intakes. Given this lack of robust evidence, a conclusion is not drawn regarding nutrient intakes and eating frequency.

Evidence Summary Paragraphs


Kerver et al, 2006 (positive quality), conducted a cross-sectional study to test the hypothesis that specific meal and snack patterns are associated with selected nutrient intakes in US adults. Using the 24-hour dietary recall from the Third National Health and Nutrition Examination Survey (NHANES), meal and snack patterns were described in relation to nutrient intakes. The study included US adults aged 20 years or older (N=15,978). On average, subjects reported a daily eating frequency of 4.90 (SE=0.04) with a range of one to 18 (median=4.18; mode=4). Daily eating frequency was categorized into five groups (one to two, three, four, five and six or more) based on distribution of the data. More frequent eaters (six or more times a day) were more likely to be middle aged (40 to 59 years), white, smokers, heavier drinkers, vitamin and mineral supplement users, with higher income and education levels than less-frequent eaters (one to two times a day). The most common meal pattern (31.6%) consisted of breakfast (B), lunch (L), dinner (D), and two or more snacks (S). Subjects who reported consuming this meal pattern were more likely to be female, middle-aged (40 to 59 years), white, nonsmokers, moderate drinkers, vitamin and mineral supplement users with higher education and income levels and moderate activity levels (33rd to 66th percentile). After controlling for the effects of age, sex, ethnicity, smoking status, alcohol intake, vitamin and mineral supplement use, body mass index (BMI), physical activity, income and energy intakes, daily eating frequency was positively related to carbohydrate (CHO) ($51.1 \pm 0.4\%$ of energy), folic acid ($302 \pm 4\text{mcg}$), vitamin C ($11.3 \pm 3.3\text{mg}$), calcium $887 \pm 12\text{ mg}$, magnesium ($330 \pm 3\text{mg}$), iron ($16.4 \pm 0.3\text{mg}$), potassium ($3,088 \pm 28\text{ mg}$) and fiber ($17.6 \pm 0.2\text{g}$), and inversely related to protein ($14.9 \pm 0.1\%$ of energy), total fat (32.7 ± 0.3 of energy), cholesterol ($261 \pm 5\text{mg}$) and sodium ($3,500 \pm 34\text{mg}$) intakes. The groups reporting B, L, D and one S and B, L, D, and two or more S had the highest intakes of all micronutrients examined except cholesterol, vitamin B₆ and sodium, which were consumed in the highest amounts by the B, L, D, group (cholesterol= $323 \pm 10.2\text{mg}$; vitamin B₆= $2.10 \pm 0.05\text{mg}$; and sodium= $3,946 \pm 48.4\text{mg}$). These findings suggest that meal and snack patterns may be markers for nutrient intakes and therefore diet quality.



Storey et al, 2009 (positive quality), conducted a cross-sectional study to identify whether students with poor diet quality had different macronutrient intakes, increased consumption of “other foods” and increased frequency of suboptimal meal behaviors (skipping meals and consuming meals away from home) in comparison with those with average or superior diet quality. Data included 2,850 Alberta and Ontario adolescents aged 14 to 17 years and diet quality was assessed using a food-based diet quality index modified to reflect the Canada’s Food Guide to Healthy Eating (CFGHE) (Poor, zero to one; Average, two to three; Superior, all four food groups). Univariate analysis revealed that those with poor diet quality had a lower frequency of breakfast (three or fewer days a week) consumption than did those with average and superior diet quality (every day); $P=0.002$. Frequency of consuming meals away from home yielded significant main effects for diet quality (Wilks’ $\lambda=0.97$, $F(12, 4,810)=5.63$, $P<0.001$). Those with poor diet quality consumed significantly more meals or snacks (once a week) away from home at all locations than did those with superior diet quality (once a month).

Macdiarmid et al, 2009 (neutral quality), used cross-sectional data (N=56) from the National Survey of Sugar Intake among children in Scotland to investigate the meal and snacking patterns of school-aged children (five to 17 years old). Meals and snacks were defined by a food-based classification system based on ‘core’ (foods normally eaten as part of a traditional meal) and ‘non-core’ (foods and drinks easily consumed outside of a meal) foods. A meal was defined as an event containing one or more ‘core’ foods with or without ‘non-core’ foods or drinks, and a snack was defined as an event containing only ‘non-core’ foods or drinks. Seventy-eight percent of children had an average of between 2.5 and 3.5 meals per day and 98% of children ate one or more snacks. Boys ate significantly more meals than girls but a similar number of snacks, and children in the high-deprivation group ate more meals and fewer snacks than those in the lower-deprivation group. The number of meals and snacks eaten did not differ by age or BMI group. The median (inter-quartile range) number of items eaten within a snacking event was two (one to two) and in a meal was four (three to five) items [two (one to two) ‘core’ and two (one to three) ‘non-core’ items]. The average daily intake of saturated fatty acids (SFA) and non-milk extrinsic sugars (NMES) (% food energy) was higher from snacks than meals, but there

was no difference in total fat. The number of meals, snacks, and total eating events per day and daily energy and nutrient intake (total fat, SFA and NMES) on weekdays did not differ between term-time and school holidays. The significant difference in the number of meals eaten on weekdays compared with weekend days was due to the wider variation in frequency of meals on weekdays rather than a difference in the median frequency. Despite the differences in meal frequency, the average daily energy, total fat, SFA and NMES intake (% food energy) did not differ significantly between weekdays and weekend days. In conclusion, children tended to follow a traditional pattern of three meals a day, which was consistent between age and BMI subgroups and between term-time and holidays.

 [View table in new window](#)

Author, Year, Study Design, Class, Rating	Study Subjects	Data Collection Instruments and Methods	Definitions of Meals	Prevalence of Meal Frequency	Key Outcomes
<p>Kerver JM, Yang EJ et al, 2006</p> <p>Study Design: Cross-sectional design</p> <p>Class: D</p> <p>Rating: </p>	<p>Data from the NHANES III 1988 to 1994.</p> <p>N=15,978.</p> <p>Age: Adults 20 years or older.</p> <p>52.6% female; 82.7% non-Hispanic white; 11.8% non-Hispanic black; 5.5% Mexican-American.</p>	<p>24-hour diet recall.</p>	<p>B=self-identified first eating occasion in 24-hour recall.</p> <p>Eating frequency per day * one to two times a day; * three times a day; * four times a day; * five times a day; * six or more time a day.</p> <p>Eating intake patterns of B, Lunch (L), Dinner (D), Snacks (S):</p> <ul style="list-style-type: none"> * B, L, D, \geq two S * B, L, D, one S * B, L, \geq two S * B, L, D * L, D, \geq two S * Other. <p>B Skipper = L, D, \geq two S eating pattern.</p>	<p>Daily eating frequency = 4.90 (SE=0.04); range = one to 18; median = 4.18; mode = four.</p> <p>Most common meal pattern = B, L, D and \geq two S (31.6%).</p>	<p>Daily eating frequency was positively related to CHO (51.1\pm0.4% of energy), folic acid (302\pm4ug), vitamin C (11.3\pm3.3mg), calcium (887\pm12mg), magnesium (330\pm3mg), iron (16.4\pm0.3mg), potassium (3,088\pm28mg) and fiber (17.6\pm0.2g) and inversely related to protein (14.9\pm0.1% of energy), total fat (32.7\pm0.3 of energy), cholesterol (261\pm5mg) and sodium (3,500\pm34mg) intakes.</p> <p>Groups reporting B, L, D, and one S and B, L, D, and \geq two S had the highest intakes of all micronutrients examined, except cholesterol, vitamin B₆ and sodium, which were consumed in the highest amounts by the B, L, D, group (cholesterol=323\pm10.2mg; vitamin B₆=2.10\pm0.05mg and sodium=3,946\pm48.4mg).</p>
<p>Storey KE, Hanning RM et al, 2009</p> <p>Study Design: Cross-sectional study</p> <p>Class: D</p>	<p>Data from Alberta and Ontario Adolescents Study.</p> <p>N=2,850.</p> <p>Age: 14- to 17-year-old male adolescents.</p>	<p>24-hour recall (one weekday).</p> <p>Self administered web-based survey (nutrient intakes and meal behaviors).</p>	<p>Frequency of meal consumption: How often do you usually eat breakfast, lunch, dinner, morning snacks, afternoon</p>	<p>Meal frequency for superior diet quality:</p> <ul style="list-style-type: none"> B=4.38\pm0.17 L=4.68\pm0.12 D=4.87\pm0.08. <p>Meal frequency for poor diet quality:</p>	<p>Those with poor diet quality had a \downarrow frequency of breakfast (three or fewer days a week) consumption than did those with average and superior diet quality (every day); P=0.002.</p>


Rating: 		<p>Diet quality was assessed using a food-based diet quality index modified to reflect the Canada's Food Guide to Healthy Eating (CFGHE) numbers:</p> <ul style="list-style-type: none"> • Poor: Zero to one • Average: Two to three • Superior: All four food groups. 	<p>snacks, evening snacks?</p> <p>Frequency of meals away from home: How often do you eat meals or snacks prepared away from home?</p> <p>Mean of morning, afternoon, evening snacks = overall frequency of snack consumption.</p>	<ul style="list-style-type: none"> • B=3.89±0.06 • L=4.46±0.05 • D=4.83±0.03 • S=3.41±0.05. 	<p>Frequency of consuming meals away from home yielded significant main effects for diet quality [Wilks' lambda=0.97, F (12, 4,810) = 5.63, P<0.001].</p> <p>Those with poor diet quality consumed significantly more meals or snacks (once a week) away from home at all locations, than did those with superior diet quality (once a month).</p>
<p>Macdiarmid J, Loe J et al, 2009</p> <p>Study Design: Cross-sectional study</p> <p>Class: D</p> <p>Rating: </p>	<p>Data from a cross-sectional data from the National Survey of Sugar Intake among children in Scotland.</p> <p>N=156</p> <p>Age: Five- to 17-year-old adolescents.</p>	<p>Four-day non-weighed diet diary (three weekdays and one weekend day).</p>	<p>Meals and snacks were defined by a food-based classification system based on 'core' (foods normally eating as part of a traditional meal) and 'non-core' (foods and drinks easily consumed out with a meal) foods.</p> <p>Meal: Eating event containing one or more 'core' foods with or without 'non-core' foods or drinks.</p> <p>Snack: Eating event containing only 'non-core' foods or drinks.</p>	<p>Total eating events per day (median inter-quartile range):</p> <ul style="list-style-type: none"> • Term-time (N=114)=5.3(5.0 to 6.3) • School holidays (N=34)=5.3(4.6 to 6.0) • Weekdays (N=106)=5.3(5.0 to 6.1) • Weekend day (N=106)=5.0(4.0 to 6.0). 	<p>78% of children had an average of between 2.5 and 3.5 meals per day.</p> <p>Boys ate significantly more meals than girls but a similar number of snacks.</p> <p>Children from lower socio-economic groups ate more meals and fewer snacks than those in the high socio-economic group.</p> <p>Number of meals and snacks eaten did not differ by age or BMI median (inter-quartile range).</p> <p>The number of items eaten within in a meal was four (three to five) items [two (one to two) 'core' and two (one to three 'non-core' items].</p> <p>Average daily intake of SFA and non-milk extrinsic sugars (NMES) (% food energy) was ↑ from snacks than meals, but there was no difference in total fat.</p> <p>Number of meals, snacks and total eating events per day and daily energy and nutrient intake (total fat, SFA and NMES) on weekdays did not differ between term-time and school holidays.</p>

					Total fat, SFA and NMES intake (% food energy) did not differ significantly between weekdays and weekend days.
--	--	--	--	--	--


Research Design and Implementation Rating Summary

For a summary of the Research Design and Implementation Rating results, [click here](#).

Worksheets

 [Kerver JM, Yang EJ, Obayashi S, Bianchi L, Song WO. Meal and snack patterns are associated with dietary intake of energy and nutrients in US adults. *J Am Diet Assoc* 2006; 106: 46-53.](#)

 [Macdiarmid J, Loe J, Craig LC, Masson LF, Holmes B, McNeill G. Meal and snacking patterns of school-aged children in Scotland. *Eur J Clin Nutr* 2009; 63: 1,297-1,304.](#)

 [Storey KE, Hanning RM, Lambraki IA, Driezen P, Fraser SN, McCargar LJ. Determinants of diet quality among Canadian adolescents. *Can J Diet Pract Res*. 2009 Summer; 70 \(2\): 58-65.](#)